

Visual Question Answering

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Abstract—Visual Question Answering is a multi-disciplinary task and where the challenge is to predict an answer of a given question related to an image. We have selected a subset of MSCOCO dataset for the home interiors domain. These images are classified into four categories viz. bathroom, bedroom, kitchen, and living room. This paper compares the Image Classification performance of various shallow learning and deep learning methods for our dataset. Through experimental evaluation of various models, we show that the Inception model outperforms Spark and Clarifai models. A web application is built to enable the user to select an image and perform image classification using Spark, Clarifai and Inception model. The web application also allows the user to ask the system to draw a bounding box around a given object. A smartphone app is also developed to allow image classification using Spark, Clarifai, Inception model and Tensorflow Lite.

Index Terms—visual question answering, bounding box, darknet, inception, tensorflow, clarifai, spark, performance, MS COCO dataset, home interiors

I. INTRODUCTION

THE motivation for undertaking VQA project was primarily our interest in doing a challenging project in multi-discipline Artificial Intelligence. In this present tech era, with AI research and computer vision on demand, we want to work on images to train the machine, see its analyzing capabilities and improve its accuracy.

The goal of this project is to implement the visual question answering system using an open source neural network framework, Darknet [1]. The system would draw a bounding box in the image for the given question. The paper also evaluates the performance of various image classification techniques including Spark (Shallow Learning), Clarifai, and Tensorflow Inception model (Deep Learning). The dataset used in the project is a subset of MS COCO dataset for home interiors do-main.

A web application is built to enable the user to select an image and perform image classification using Spark, Clarifai and Inception model. The web application also allows the user to ask the system to draw a bounding box around a given object. A smartphone app is also developed to allow image classification using Spark, Clarifai, Inception model and Tensorflow Lite.

In this paper, we share our experiences on implementing various image classification methods. In Section II, we list projects with similar aims like VQA. In Section III, we outline our approach. In Section IV, we describe how to implement a visual question answering system on web as well as on a smartphone. In Section V, we present the dataset and

performance evaluation results over various models. Finally, we conclude the paper in Section VI.

II. RELATED WORK

VQA poses a rich set of challenges, many of which have been viewed as the holy grail of automatic image understanding and AI in general. However, it includes as building blocks several components that the CV, NLP, and KR communities have made significant progress on during the past few decades [2].

There have been several papers that are working on tasks of image tagging like [3, 4], image captioning [5, 6] and text-based Q&A [7, 8]. A team from MIT has worked on ‘Simple Baseline for Visual Question Answering’ [9]. The Show and Tell model also uses the COCO dataset for the same task [10].

However, there are no projects that are focusing on the interiors domain; this makes our application a one of a kind.

III. APPROACH

In this section, we outline the data sources, analytic algorithms, tasks, platforms, expected input/output and evaluation of different models.

A. Data Sources

We have collected a subset of home interior images from MS COCO dataset [11]. The dataset consists of images, questions and answers. The images are classified into four categories viz. bathroom, bedroom, kitchen, and living room.

B. Analytic Algorithms

The following algorithms were used for image classification:

- Shallow Learning – Random Forest, Decision Tree, Naïve Bayes using Spark API
- Deep Learning – Softmax, CNN, Inception model using Flask API
- Clarifai model

C. Tasks

The following tasks were performed:

- Building Random Forest, Decision Tree, Naïve Bayes models for image classification
- Fuzzy image classification using Clarifai API
- Converting the project data to MNIST format for Softmax and CNN models

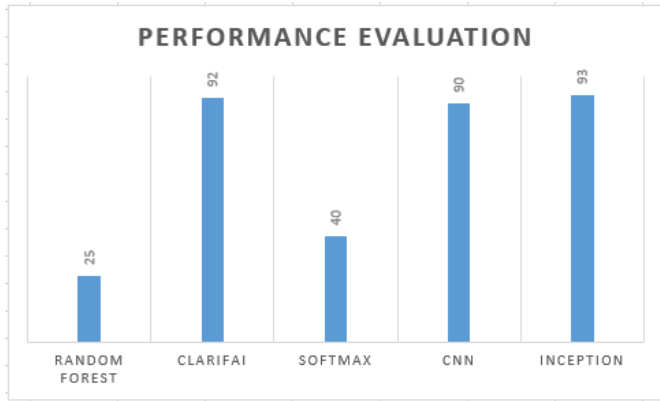


Fig. 1. Performance evaluation of various shallow learning and deep learning models on the home interiors dataset. Horizontal axis represents the model and the vertical axis represents the accuracy of the model.

- Building Softmax, CNN and Inception models for image classification
- Building the darknet model for Bounding Box

D. Platforms

The following platforms were used:

- IntelliJ for shallow learning models
- PyCharm for deep learning models
- Android Studio for android application
- Webstorm for web application

E. Expected Input / Output

- Input: Image from a dataset of home interiors. Additional input of a question for the bounding box
- Output: Classification of image into one of the four categories. A bounding box for the given question

F. Evaluation

Fig. 1. shows the performance evaluation of the following models:

- Random Forest (Spark): 25% Accuracy
- Clarifai: 92% Accuracy
- Softmax: 40% Accuracy
- CNN: 90% Accuracy
- Inception: 93% Accuracy

IV. IMPLEMENTATION DETAILS

In this section, we describe implementation details including software architecture diagram, activity diagram and sequence diagram.

A. Software Architecture Diagram

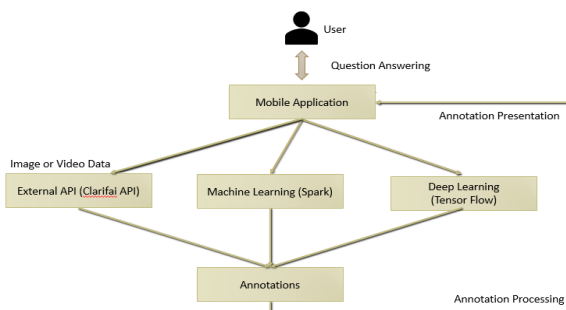


Fig. 2. Proposed architecture diagram

B. Activity Diagram

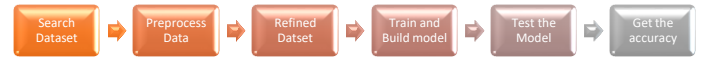


Fig. 3. Activity diagram for the proposed model

C. Sequence Diagram

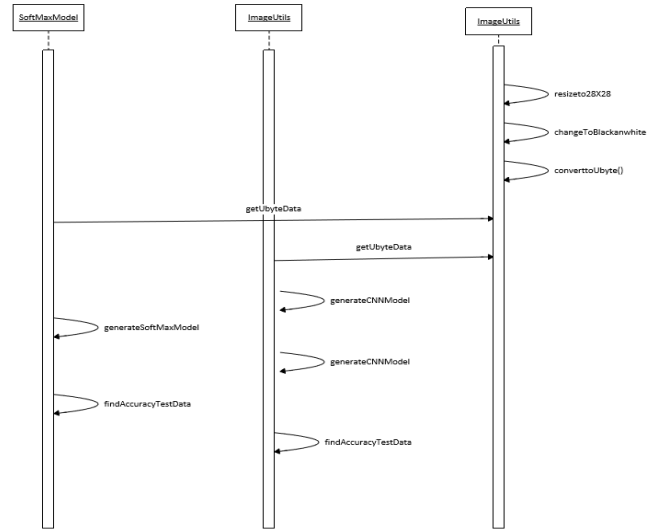


Fig. 4. Sequence diagram for the proposed model

D. Feature Specification

The following list includes all the features of our application:

- Image Classification using Random Forest model using Spark API
- Image Classification using Clarifai API
- Image Classification using Inception model using Flask API
- Visual Question Answering via a bounding box
- Object Detection using Tensorflow Lite
- A web application and an android application

E. Existing Application/Services Used

The following existing services were used for our application:

- Flask API
- Clarifai API
- Inception model
- Darknet for bounding box

V. RESULTS

In this section, we present the dataset and performance evaluation results over various models.

A. Dataset

We have collected a subset of home interior images from MS COCO dataset [11]. The dataset consists of images, questions and answers. The images are classified into four categories viz. bathroom, bedroom, kitchen, and living room. There are 50 training images and 5 test images in each category.

B. Evaluation

The following table lists the performance for all models in the

experimentation:

TABLE I
PERFORMANCE EVALUATION FOR SHALLOW AND DEEP LEARNING MODELS

Model	Accuracy
Random Forest	25%
Decision Tree	15%
Naïve Bayes	15%
Clarifai	92%
Softmax	40%
CNN (Adam)	90%
CNN (Adagrad)	43%
Inception	93%

Performance evaluation of various shallow learning and deep learning models on the home interiors dataset.

The following figures describe Zenhub boards and burndown charts:

i. Zenhub Board

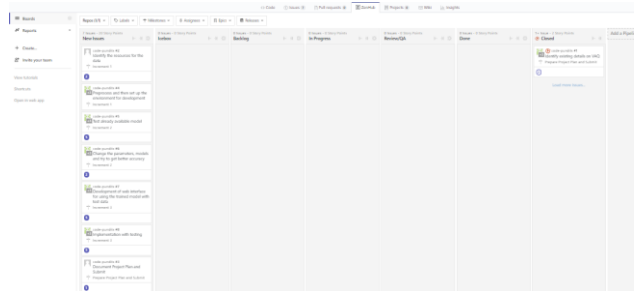


Fig. 5. Zenhub Board

ii. Milestones

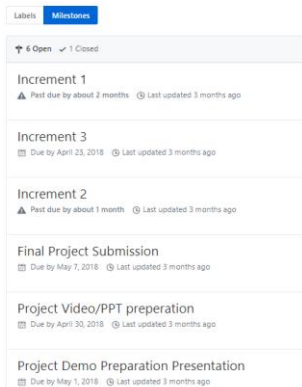


Fig. 6. Zenhub milestones

iii. Burndown Chart

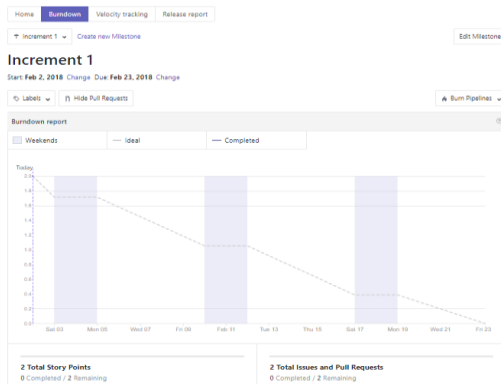


Fig. 7. Zenhub burndown chart

The following are the screenshots of our application:

i. Web Application:

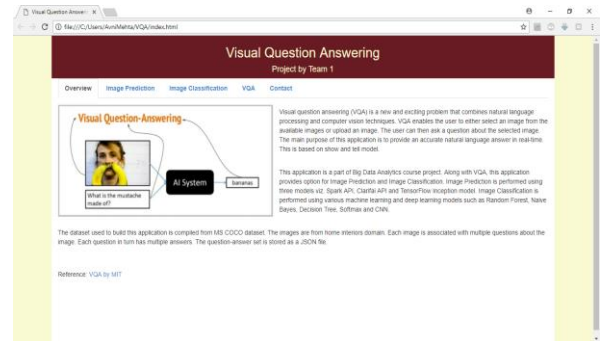


Fig. 8. Web Application - Overview

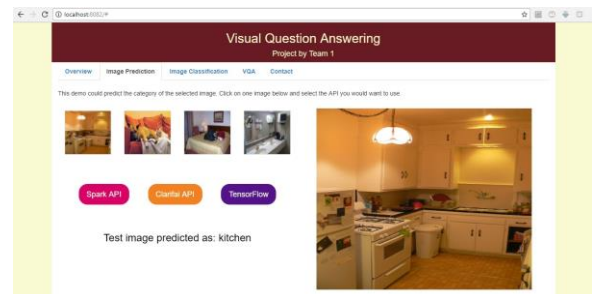


Fig. 9. Web Application – Image Prediction

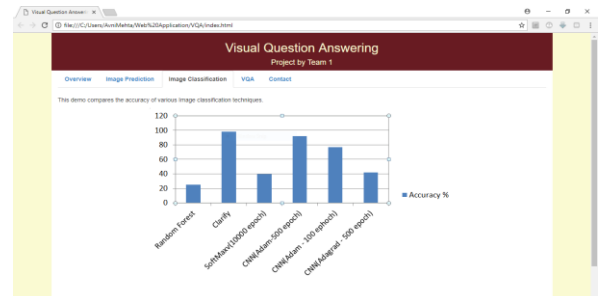


Fig. 10. Web Application – Evaluation

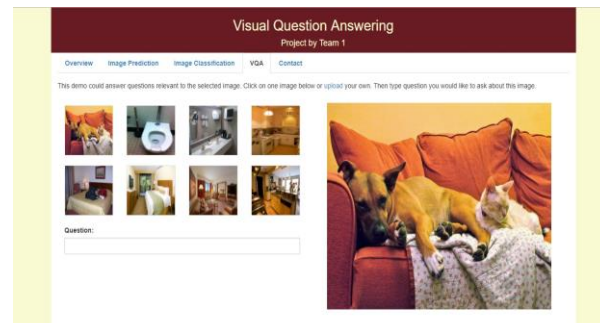


Fig. 11. Web Application - VQA

ii. Android Application:

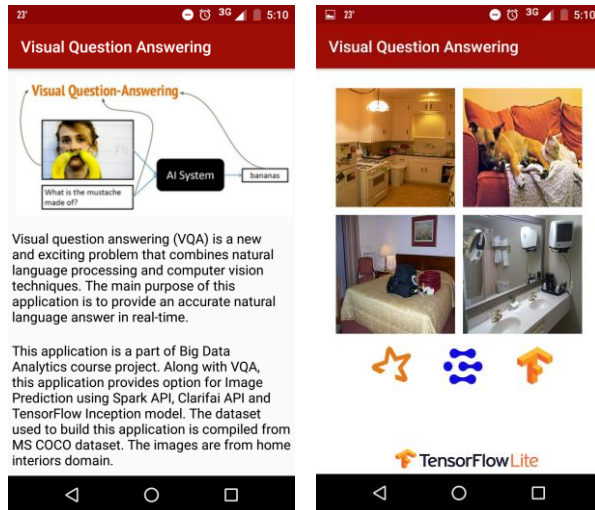


Fig. 12. Android Application

iii. Bounding Box VQA:

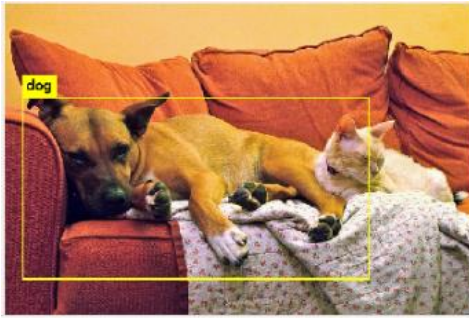


Fig. 13. Bounding box for the question "Where is the dog?"

VI. CONCLUSION

In this paper we have presented experimental results on various methods for Image Classification. VQA is achieved by the means of a bounding box around the given object.

As future work, we plan to build a VQA system that predicts the answer to the question related to the image.

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